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EXAMINER	
PEREZ, JAMES M	
ART UNIT	**PAPER NUMBER**
2611	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)
	10/680,839	MARAVIC ET AL.
	Examiner	**Art Unit**
	JAMES M. PEREZ	2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _19 February 2009_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-62_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-62_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _07 October 2003_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Detailed Action

This action is responsive to the Request for Continued Examination (RCE) filed on 2/19/2009.

Currently claims 1-62 are pending.

Response to Arguments

1. Applicant's arguments with respect to claims 1-62 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-8, 16-18, 20-21, 29, 34-41, 49-51, 53-54, and 61-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000).

With regards to claims 1, 29, 34, and 61-62, Affes teaches a receiver, mobile station, and method for processing a signal sent over a wireless communication channel (abstract and paragraphs 14-23), comprising:

at least one antenna (fig. 1: elements 12.1 through 12.M); and

a receiver configured to receive a signal over a wireless communication channel (paragraphs 14-23), and sample the received signal with a sampling frequency (rate) lower than the sampling frequency given by the Shannon theorem (figs. 6 and 9: elements 18 and 23: paragraphs 119 and 138) for generating a set of sampled values (figs. 6 and 9: elements 18 and 23: paragraphs 119 and 138), wherein said sampling frequency is the chip rate (figs. 6 and 9: elements 18 and 23: paragraphs 119 and 138).

Affes does not explicitly teach the sampling rate is lower than the chip rate of said received signal, but greater than the rate of innovation of said received signal.

Unser teaches the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B).

One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious that Unser discloses sampling a signal at the rate of innovation for reconstructing in the digital domain. Furthermore, one of ordinary skill in the art at the time of the invention would clearly recognize the benefits of optimizing the sampling frequency, where sampling at a lower rate has the advantages of decreasing processing speed and power dissipation of the processing elements, while sampling at a higher rate decreases distortion (due to aliasing) in the sampled signal.

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify (lower) the sampling rate (frequency) of Affes with the teachings Unser in order to sample the received signal at a frequency lower than the chip rate of

said received signal, but greater than the rate of innovation of said received signal, since such a modification has the advantages of minimizing the receiver complexity (i.e. processing speed and power dissipation), and minimizing the distortion (due to aliasing) introduced into the wanted signal due to sampling below the Nyquist frequency (rate).

With regards to claims 2-3 and 35-36, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes teaches pre-processing of the received signal (fig. 13: element 18).

Affes does explicitly teach the preliminary step of filtering said received signal (y(t)) with a filter (f).

Unser teaches pre-filter using a low-pass filter (Section II: fig. 2)

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the spread spectrum communication sampling method of Affes with the sampling method disclosed by Unser in order to create an improved method and system for sampling and reconstructing the information from the original signal while minimizing errors in the reconstructed information.

With regards to claims 4 and 37, Affes in view of Unser teaches the limitations of claim 3 and 36.

Affes teaches pre-processing of the received signal (fig. 13: element 18).

Affes does explicitly teach said filter (f) is a sinc filter.

Unser teaches the use of a sinc filter (Section II: fig. 2).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the spread spectrum communication sampling method of Affes with the sampling method disclosed by Unser in order to create an improved method and system for sampling and reconstructing the information from the original signal while minimizing errors in the reconstructed information.

With regards to claims 5 and 38, Affes in view of Unser teaches the limitations of claims 3 and 36.

Affes teaches pre-processing of the received signal (fig. 13: element 18).

Affes does explicitly teach said filter (f) is a Gaussian filter.

Unser teaches the use of B-splines with a Gaussian-like response as the n degree increases (Section III: fig. 3). One of ordinary skill in the art would clearly recognize that Gaussian filters have fast decay which would allow for more accurate signal filtering while minimizing computational burden in a digital system. Therefore it would have been obvious to one of ordinary skill to use a Gaussian filter to pre-filter the input signal in order to for more accurate signal filtering while minimizing computational burden in a digital system.

With regards to claims 6 and 39, Affes in view of Unser teaches the limitations of claims 1 and 38.

Affes teaches said wireless communication channel comprises: a multipath fading transmission channel (paragraph 116).

With regards to claims 7 and 40, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes teaches said wireless communication channel comprises: a CDMA system (paragraph 116-117).

With regards to claims 8 and 41, Affes in view of Unser teaches the limitations of claims 1 and 34, including sampling at a frequency between the chip rate (frequency) and rate of innovation.

Affes does not explicitly teach said sampling at a frequency greater than the information rate of the received signal.

Unser teaches the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B).

One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious that Unser obviously discloses sampling a signal at the rate of innovation for reconstructing in the digital domain. Furthermore, one of ordinary skill in the art at the time of the invention would clearly recognize that the rate of innovation

(defined by the degree of freedom) is at least equal to the information rate (symbol/baud rate).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify (lower) the sampling rate (frequency) of Affes with the teachings Unser in order to sample the received signal at a frequency lower than the chip rate of said received signal, but greater than the rate of innovation and information rate of said received signal, since such a modification has the advantages of minimizing the receiver complexity (i.e. processing speed and power dissipation), and minimizing the distortion (due to aliasing) introduced into the wanted signal due to sampling below the Nyquist frequency.

With regards to claims 16 and 49, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes further teaches the method wherein said sent signal includes a plurality of symbols (figs. 1-2: elements 10, and 13-16) each encoded with said user specific coding sequence (figs. 1-2: elements 10, and 13-16) and transmitted by said users (figs. 1-2: elements 10, and 13-16), said method further comprising the steps of

running a multiuser detection scheme (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) using known delays (paragraphs 178-186) and amplitude attenuations (paragraph 114) induced by said communication signal on said sent signal (figs. 1-2, 5, and 9: signal X(t)) and using said set of sampled values (fig. 16: output of element 18) and for

estimating the value of the symbol (fig. 16: elements 29: paragraph 21) sent by each said user (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated).

With regards to claims 17 and 50, Affes in view of Unser teaches the limitations of claims 16 and 49.

Affes further teaches said multiuser detection scheme (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) is a decorrelating detection scheme (paragraph 7).

With regards to claims 18 and 51, Affes in view of Unser in further view of Agee teaches the limitations of claims 16 and 49.

Affes further teaches said multiuser detection scheme (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) is a minimum mean-square error detection scheme (paragraph 8).

With regards to claims 20 and 53, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes teaches said sent signal includes a plurality of symbols (fig. 2: elements b.sub.n and 13: paragraphs 302-306) each encoded with a user specific coding sequence (sk(t)) (paragraphs 302-306) being chosen, method further comprising the steps of:

sampling the received signal (y(t)) with a sampling frequency (fs) lower than the sampling frequency given by the Shannon theorem (paragraph 119) for generating a set of sampled values (fig. 9: output of element 18).

filtering said set of sampled values (y(nTs)) with a bank of matched filters (fig. 16: element group 19: paragraph 119), each filter being matched to said user specific coding sequence (fig. 16: element group 19: despreader) filtered, for estimating the value of the symbol (bk) sent by each said user (fig. 16: elements 19, 42, 29-30).

Affes does not teach that when lowpass filtered, the signal is orthogonal to any other user's specific coding sequence (sk(t)) used in said communication channel; the sampling rate is greater than the rate of innovation (rho) of said received signal (y(t)); and said match filter uses a lowpass filter.

Unser teaches that when lowpass filtered, the signal is orthogonal to any other user's specific coding sequence (sk(t)) used in said communication channel (Section II and fig. 2);

said match filter uses a lowpass filter (Section II and fig. 2); and

the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B).

One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious that Unser discloses sampling a signal at the rate of innovation for reconstructing in the digital domain. Furthermore, one of ordinary skill in

the art at the time of the invention would clearly recognize the benefits of optimizing the sampling frequency, where sampling at a lower rate has the advantages of decreasing processing speed and power dissipation of the processing elements, while sampling at a higher rate decreases distortion (due to aliasing) in the sampled signal.

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify (lower) the sampling rate (frequency) of Affes with the teachings Unser in order to sample the received signal at a frequency lower than the chip rate of said received signal, but greater than the rate of innovation of said received signal, since such a modification has the advantages of minimizing the receiver complexity (i.e. processing speed and power dissipation), and minimizing the distortion (due to aliasing) introduced into the wanted signal due to sampling below the Nyquist frequency (rate).

With regards to claims 21 and 54, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes teaches said communication channel comprises an array of antennas (fig. 1: antennas 1 through M).

4. Claims 9-15, 19, 22-25, 30, 42-48, 52, and 55-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000.) as applied to claims 1, 21, 30, 34, and 54, and further in view of Agee (US 2003/0123384).

With regards to claims 9 and 42, Affes in view of Unser teaches the limitations of claims 1 and 34.

Affes teaches said sent signal includes a plurality of training sequences (paragraphs 302-306: pilot symbol) each encoded with a user specific coding sequence (paragraphs 114, 132-134, and 302-306: user spreading code, denoted as ‘c’) and transmitted by said users (k) (paragraphs 114, 132-134, and 302-306: users), said method further comprising the steps of:

retrieving the delays (paragraphs 132-134 and 178-186: propagation delay, denoted as ‘τ’, tau) and the amplitude attenuations (paragraphs 114, 132-134, and 178-186: power along each path, denoted as ‘ε’, epsilon) induced by said communication channel on said sent signal (paragraphs 114, 132-134, and 178-186), corresponding to said received signal (114, 132-134, and 178-186) and corresponding to each of said user specific coding sequence (paragraphs 114, 132-134, and 178-186: user spread code);

Affes does not explicitly teach determining the set of spectral values corresponding to said received signal from said set of sampled values, recovering spectral values corresponding to each of said user specific coding sequence, wherein the determined amplitude and delays were determined from spectral values of the signal and spectral values of the user specific coding sequence.

Agee teaches determining a set of spectral values corresponding to said received signal from said set of sampled values (figs. 8-9: elements 234, 236, 264, and 266: paragraphs 15, 30, 57, 108, 118, and 124);

recovering spectral values corresponding to each of said user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124);

wherein the determined amplitude and delays (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation/multipath delay and fading) were determined from spectral values of the signal and spectral values of the user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation delay and channel fading).

One of orindary skill in the art at the time of the invention would clearly recognize the benefits of performing the described above in the spectral (frequency) domain, since such a modification has the advantages simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset. Therefore it would be obvious to one of orindary skill in the art at the time of the invention to modify the CDMA receiver of Affes with the teachings of Agee since such a modification has the benefits of simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset.

With regards to claims 10 and 43, Affes in view of Unser in further view of Agee teaches the limitations of claims 9 and 42.

Affes teaches retrieving said delays and said amplitude attenuations includes solving a series of one-dimensional estimation problems (paragraphs 55 and 230:

wherein receiver only has one antenna), the size of each said one-dimensional estimation problem being equal to the number of said sampled values generated during one symbol duration (fig. 16: element 29: paragraph 21).

With regards to claims 11 and 44, Affes in view of Unser in further view of Agee teaches the limitations of claims 10 and 43.

Affes further teaches said series of one-dimensional equation systems (figs. 16 and 44: elements 59, 43, 47, 25, and 29-32) is derived from said received signal (fig. 44: element 18), each of said user specific coding sequence (fig. 44: element 19) and the value of the bits of said training sequences (fig. 44: elements 29-35).

Affes does not explicitly teach the spectral value of the received signal and said user specific coding.

Agee teaches the use of Fast Fourier transform (FFT) before the dispreading unit (figs. 8-9: element 236, 242, 266, and 272) computing a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (fig. 7B and 8-9: ADC output, and front end);

recovering spectral values (Sk[m]) corresponding to each of said user specific coding sequence (figs. 8-9: elements 242 and 272).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the CDMA-OFDM communication system of Affes with the CDMA-OFDM system of Agee in order to create an improved system and method with lower complexity by using simple equalization of linear channel distortion (paragraph 30).

With regards to claims 12 and 45, Affes in view of Unser in further view of Agee teaches the limitations of claims 11 and 44.

Affes further teaches processing a second sent signal (figs. 1 and 16: element group 10, 14, and output to other receiver for other desired users) including a plurality of symbols (fig. 1 and 2: elements 13-16) each encoded with said user specific coding sequence (sk(t)) and transmitted by said users (k), sampling said second sent signal (y(t)) with a sampling frequency lower than the sampling frequency given by the Shannon theorem (paragraph 119).

Affes does not explicitly teach the sampling rate is greater than the rate of innovation (rho) of said received signal (y(t)).

Unser teaches the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B). One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious to sample at a greater than or equal to the rate of innovation in order to reconstruct information of the original signal with minimum error. Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the spread spectrum communication sampling method of Affes with the sampling method disclosed by Unser in order to create an improved method and system for sampling and

reconstructing the information from the original signal while minimizing errors in the reconstructed information.

With regards to claims 13 and 46, Affes in view of Unser in further view of Agee teaches the limitations of claims 12 and 45.

Affes further teaches running a multiuser detection scheme using said second set of sampled values (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) and previously computed said delays (paragraphs 178-186) and said amplitude attenuations (paragraph 114) for estimating the value of the symbol (bk) sent by each said user (fig. 16: elements 29: paragraph 21).

With regards to claims 14 and 47, Affes in view of Unser in further view of Agee teaches the limitations of claims 13 and 46.

Affes further teaches said multiuser detection scheme (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) is a decorrelating detection scheme (paragraph 7).

With regards to claims 15 and 48, Affes in view of Unser in further view of Agee teaches the limitations of claims 13 and 46.

Affes further teaches said multiuser detection scheme (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is

repeated) is a minimum mean-square error detection scheme (paragraph 8).

With regards to claims 19 and 52, Affes in view of Unser teaches the limitations of claims 1 and 34, including sampling between the chip rate and rate of innovation.

Affes teaches said sent signal includes a plurality of training sequences (paragraphs 302-306) each encoded with a user specific coding sequence (sk(t)) (paragraphs 302-306) and transmitted by said users (k) (paragraphs 302-306), said method further comprising the steps of:

computing a set sampled values from said received signal (fig. 16: output of element 18).

computing a set of channel dependant values (figs. 1-2, 5, and 9: signal X(t): paragraphs 114 and 178-186) from the sampled signal (fig. 44: output of element 18) and said training sequences (fig. 44: paragraphs 302-306).

processing a second sent signal (figs. 1 and 16: element group 10, 14, and output to other receiver for other desired users) including a plurality of symbols (fig. 1 and 2: elements 13-16) each encoded with said user specific coding sequence (sk(t)) and transmitted by said users (k), sampling said second sent signal (y(t)) with a sampling frequency lower than the sampling frequency given by the Shannon theorem (paragraph 119).

retrieving the value of the symbol (figs. 16 and 44: elements 28-30, 47, 43, 29-35) by each said user by solving a linear matrix system (figs. 16 and 44: elements 28-30, 47, 43, 29-35) including said second set of sampled values (figs. 16 and 44: output

of element 18: "to receivers for other desired users": note that the recovery process is repeated for each desired user) and said set of channel dependant values (figs. 16 and 44: elements 28-30, 47, 43, 29-35)).

Affes does not explicitly teach determining the a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (y(nTs)), wherein the determined channel values were determined from spectral values of the signal and spectral values of the user specific coding sequence.

Affes does not explicitly teach determining the a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (y(nTs)), wherein the determined channel values were determined from spectral values of the signal and spectral values of the user specific coding sequence.

Agee teaches determining a set of spectral values corresponding to said received signal from said set of sampled values (figs. 8-9: elements 234, 236, 264, and 266: paragraphs 15, 30, 57, 108, 118, and 124);

recovering spectral values corresponding to each of said user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124);

wherein the determined amplitude and delays (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation/multipath delay and fading) were determined from spectral values of the signal and spectral values of the user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation delay and channel fading).

One of orindary skill in the art at the time of the invention would clearly recognize the benefits of performing the described above in the spectral (frequency) domain, since

such a modification has the advantages simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset. Therefore it would be obvious to one of orindary skill in the art at the time of the invention to modify the CDMA receiver of Affes with the teachings of Agee since such a modification has the benefits of simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset.

With regards to claims 22 and 55, Affes in view of Unser teaches the limitations of claims 21 and 54.

Affes teaches said sent signal includes a plurality of training sequences (paragraphs 302-306) each encoded with a user specific coding sequence (sk(t)) (paragraphs 302-306) and transmitted by said users (k) (paragraphs 302-306), said method further comprising the steps of:

sampling the received signal (y(t)) from each antenna (figs. 1 and 16: elements 11-12 and 18-19) with a sampling frequency (fs) lower than the sampling frequency given by the Shannon theorem (paragraph 119) for generating a set of sampled values (fig. 9: output of element 18).

retrieving the delays (paragraphs 178-186) and the amplitude attenuations (paragraph 114) and direction of arrival (paragraphs 133-135 and 155) induced by said communication channel on said sent signal (figs. 1-2, 5, and 9: signal X(t)), corresponding to said received signal (y(t)) and corresponding to each of said user specific coding sequence (fig. 5: elements 18, 19 and 20).

Affes does not explicitly determining the a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (y(nTs)), recovering spectral values (Sk[m]) corresponding to each of said user specific coding sequence (sk(t)), wherein the determined amplitude and delays were determined from spectral values of the signal and spectral values of the user specific coding sequence; and determining the direction of arrival of the received signal.

Agee teaches determining a set of spectral values corresponding to said received signal from said set of sampled values (figs. 8-9: elements 234, 236, 264, and 266: paragraphs 15, 30, 57, 108, 118, and 124);

recovering spectral values corresponding to each of said user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124);

wherein the determined amplitude and delays (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation/multipath delay and fading) were determined from spectral values of the signal and spectral values of the user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation delay and channel fading).

One of orindary skill in the art at the time of the invention would clearly recognize the benefits of performing the described above in the spectral (frequency) domain, since such a modification has the advantages simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset. Therefore it would be obvious to one of orindary skill in the art at the time of the invention to modify the CDMA receiver of Affes with the teachings of Agee since such a modification has

the benefits of simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset.

With regards to claims 23 and 56, Affes in view of Unser in further view of Agee teaches the limitations of claims 22 and 55.

Affes teaches the step of retrieving said delays and said amplitude attenuations and directions of arrival includes solving a series of two-dimensional estimation problems (paragraphs 55 and 230: wherein receiver combines the signal from two antennas), the size of each said two-dimensional estimation problem being equal to the number of said sampled values generated during one symbol duration (fig. 16: element 29: paragraph 21).

With regards to claims 24 and 57, Affes in view of Unser in further view of Agee teaches the limitations of claims 23 and 56.

Affes teaches said sent signal includes a plurality of training sequences (paragraphs 302-306) each encoded with a user specific coding sequence (sk(t)) (paragraphs 302-306) and transmitted by said users (k) (paragraphs 302-306), said method further comprising the steps of:

sampling the received signal (y(t)) from each antenna (figs. 1 and 16: elements 11-12 and 18-19) with a sampling frequency (fs) lower than the sampling frequency given by the Shannon theorem (paragraph 119) for generating a set of sampled values (fig. 9: output of element 18).

retrieving the delays (paragraphs 178-186) and the amplitude attenuations (paragraph 114) and direction of arrival induced by said communication channel on said sent signal (figs. 1-2, 5, and 9: signal X(t)), corresponding to said received signal (y(t)) and corresponding to each of said user specific coding sequence (fig. 5: elements 18, 19 and 20);

Affes does not explicitly determining the a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (y(nTs)), recovering spectral values (Sk[m]) corresponding to each of said user specific coding sequence (sk(t)), wherein the determined amplitude and delays were determined from spectral values of the signal and spectral values of the user specific coding sequence; and determining the direction of arrival of the received signal.

Agee teaches determining a set of spectral values corresponding to said received signal from said set of sampled values (figs. 8-9: elements 234, 236, 264, and 266: paragraphs 15, 30, 57, 108, 118, and 124);

recovering spectral values corresponding to each of said user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124);

wherein the determined amplitude and delays (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation/multipath delay and fading) were determined from spectral values of the signal and spectral values of the user specific coding sequence (figs. 8-9: paragraphs 15, 30, 108, 118, and 124: propagation delay and channel fading).

One of orindary skill in the art at the time of the invention would clearly recognize the benefits of performing the described above in the spectral (frequency) domain, since

such a modification has the advantages simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset. Therefore it would be obvious to one of orindary skill in the art at the time of the invention to modify the CDMA receiver of Affes with the teachings of Agee since such a modification has the benefits of simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset.

With regards to claims 25 and 58, Affes in view of Unser in further view of Agee teaches the limitations of claims 24 and 57.

processing a second sent signal (figs. 1 and 16: element group 10, 14, and output to other receiver for other desired users) including a plurality of symbols (fig. 1 and 2: elements 13-16) each encoded with said user specific coding sequence (sk(t)) and transmitted by said users (k), sampling said second sent signal and first sent signal with a sampling frequency lower than the sampling frequency given by the Shannon theorem (paragraph 119).

Affes does not explicitly teach orienting the beams of said array of antennas (i) towards previously determined said arrival directions.

Agee teaches orienting the beams of said array of antennas (i) towards previously determined said arrival directions (paragraphs 127-135).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the CDMA communication system of Affes with the teachings of

Agee in order to create an improved system and method with lower complexity by using simple equalization of linear channel distortion and adaptive antennas.

With regards to claim 30, Affes in view of Unser teaches the limitations of claim 29.

Affes teaches comprising a memory for storing said signature sequences (fig. 16: elements 18-19: wherein the de-spreaders would inherently store the signature sequences in memory).

Affes does not explicitly teach having said spectral values of said signature sequences.

Agee teaches the use of Fast Fourier transform (FFT) before the dispreading unit (figs. 8-9: element 236, 242, 266, and 272) computing a set of spectral values (Y[m]) corresponding to said received signal (y(t)) from said set of sampled values (fig. 7B and 8-9: ADC output, and front end);

One of orindary skill in the art at the time of the invention would clearly recognize the benefits of performing the described above in the spectral (frequency) domain, since such a modification has the advantages simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset. Therefore it would be obvious to one of orindary skill in the art at the time of the invention to modify the CDMA receiver of Affes with the teachings of Agee since such a modification has the benefits of simplifying the calculation and correction of linear channel distortion, the mitigation of Doppler shifts, and carrier offset.

5. Claims 26 and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000.) with Agee (US 2003/0123384) as applied to claims 25 and 58 above, and further in view of Huang (USPN 6,370,129).

With regards to claims 26 and 59, Affes in view of Unser in further view of Agee teaches the limitations of claims 25 and 58.

Affes further teaches running a detection scheme using said second set of sampled values (fig. 16: output of element 18: to receiver for other desired users: note that the signal processing for each user is repeated) and previously computed said delays (paragraphs 178-186) and said amplitude attenuations (paragraph 114) for estimating the value of the symbol (bk) sent by each said user (fig. 16: elements 29: paragraph 21).

Affes does not explicitly teach running a 2D-RAKE.

Huang teaches using a 2D-Rake (col. 6, lines 3-25).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to combine the CDMA multi-user communication system of Affes with the teachings of Huang in order to implement an improved multi-user detection scheme which mitigates multi-user interference in a high speed mixed traffic environment (col. 2, line 1-5 and col. 5, line 62 through col. 6, line 25).

6. Claims 27 and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000.) as applied to claims 1 and 34 above, and further in view of Shattil (USPN 7,076,168).

With regards to claims 27 and 60, Affes in view of Usner teachings the limitations of claims 1 and 34, including sampling between the chip rate and rate of innovation.

Affes teaches a method for processing a signal (y(t)) sent over a wireless communication channel (paragraphs 14-23), comprising the step of sampling the received signal (y(t)) with a sampling frequency (fs) lower than the sampling frequency given by the Shannon theorem (paragraph 119) for generating a set of sampled values (fig. 9: output of element 18).

Affes does not explicitly teach said wireless communication channel is an Ultra Wideband (UWB) communication system.

Shattil teaches said bandwidth-expanding communication channel is an Ultra Wideband (UWB) communication system (col. 17, lines 1-10 and col. 19, lines 15-32).

One of orindary skill in the art at the time of the invention would clearly recognize that UWB (used as a spread spectrum technique) has the benefits of a low power frequency spectrum.

Therefore it would have been obvious to one of ordinary skill in the art to modify the CDMA system and method of Affes with the teachings of Shattil since such a modification has the benefits of a low power frequency spectrum.

7. Claims 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000.) as applied to claim 29 above, and further in view of Baum (USPN 7,218,666).

With regards to claim 31, Affes in view of Unser teaches the limitations of claim 29.

Affes teaches a set of at least two encoders (figs. 16 and 44: elements 18-19, 27-30, and 35), each encoder of said set of encoders being assigned at least one training sequence (fig. 44: elements 18, 28-32, and 35) to be sent over a bandwidth-expanding channel during a training phase (paragraphs 302-306),

Affes does not explicitly teach the at least one training sequence (paragraphs 302-306) is chosen such that it is linearly independent from any other training sequence (paragraphs 302-306) assigned to any other encoder (paragraphs 302-306) of said set of encoders.

Baum teaches the at least one training sequence (col. 12, line 40 through col. 13, line 7) is chosen such that it is linearly independent from any other training sequence (col. 12, line 40 through col. 13, line 7) assigned to any other encoder (col. 12, line 40 through col. 13, line 7) of said set of encoders.

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify the CDMA communication system of Affes with the pilot chip symbol teachings of Baum in order to create an improved system capable of more actually

measuring the frequency response of the channel with less interference from other user signals.

With regards to claim 32, Affes in view of Unser in further view of Baum teaches the limitations of claim 31.

Affes teaches a set of at least two encoders, each said encoder (50) being assigned at least one said training sequences (bkt), wherein each said encoder (50) is designed to select from said at least one training sequences (bkt) the training sequence (bkt) to be sent during said training phase (30).

Affes does not explicitly teach assigned at least two said training sequences (bkt), and said encoder is designed to select from said at least two training sequences.

Baum teaches assigned at least two said training sequences, and said encoder is designed to select from said at least two training sequences (col. 12, line 40 through col. 13, line 7).

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify the CDMA communication system of Affes with the pilot chip symbols teachings of Baum in order to create an improved system capable of more actually measuring the frequency response of the channel with less interference from other user signals.

With regards to claim 33, Affes in view of Unser in further view of Baum teaches the limitations of claim 31.

Affes teaches each of two said encoder being assigned a specific coding sequence (fig. 2: elements b_n and 13: paragraphs 302-306) for coding a signal to be sent over said bandwidth-expanding channel (fig. 2: elements b.sub.n and 13: paragraphs 302-306), wherein said coding sequence (sk(t)) is chosen such that, when filtered, for estimating the value of the symbol (bk) sent by each said user (fig. 16: elements 19, 42, 29-30).

Affes does not explicitly teach said filter being a lowpass filter such that the signal is filtered with a lowpass filter (f), it is orthogonal to any specific coding sequence (sk(t)) assigned to any other encoder (50) of said set of encoders filtered with said lowpass filter (f).

Unser teaches that when lowpass filtered, the signal is orthogonal to any other user's specific coding sequence (sk(t)) used in said communication channel (Section II and fig. 2);

said match filter uses a lowpass filter (Section II and fig. 2); and

the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B). One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious that Unser discloses sampling a signal at the rate of innovation for reconstructing in the digital domain. Furthermore, one of ordinary skill in the art at the time of the invention would clearly recognize the benefits of optimizing the sampling frequency, where sampling at a

lower rate has the advantages of decreasing processing speed and power dissipation of the processing elements, while sampling at a higher rate decreases distortion (due to aliasing) in the sampled signal.

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify (lower) the sampling rate (frequency) of Affes with the teachings Unser in order to sample the received signal at a frequency lower than the chip rate of said received signal, but greater than the rate of innovation of said received signal, since such a modification has the advantages of minimizing the receiver complexity (i.e. processing speed and power dissipation), and minimizing the distortion (due to aliasing) introduced into the wanted signal due to sampling below the Nyquist frequency (rate).

8. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Affes (US 2002/0051433) in view of Unser ("Sampling – 50 Years After Shannon", Proceedings of the IEEE, Vol. 88, No.4: pages 569-587, April 2000.), and further in view of Langberg (USPN 5,852,630).

With regards to claim 28, Affes teaches a receiver and method for processing a signal sent over a wireless communication channel (paragraphs 14-23), comprising the step of:

receiving a signal over a wireless communication channel (paragraphs 14-23), and sampling the received signal with a sampling frequency (rate) lower than the sampling frequency given by the Shannon theorem (figs. 6 and 9: elements 18 and 23:

paragraphs 119 and 138) for generating a set of sampled values (figs. 6 and 9: elements 18 and 23: paragraphs 119 and 138), wherein said sampling frequency is the chip rate (figs. 6 and 9: elements 18 and 23: paragraphs 119 and 138).

sampling the received signal with a sampling frequency lower than the sampling frequency given by the Shannon theorem (paragraph 119) for generating a set of sampled values (fig. 9: output of element 18).

Affes does not explicitly teach two Limitations: Limitation 1) the sampling rate is lower than the chip rate of said received signal, but greater than the rate of innovation of said received signal; and Limitation 2) a computer-readable medium on which is recorded a control program for a data processor, the computer-readable medium, comprising instructions for causing the data processor to perform the process as disclosed above.

Limitation 1)

Unser teaches the reconstruction of a consistent signal (which yields the same measurements as the original signal) as long as there are as many measurements (samples) as there are degrees of freedom in the signal (Section V, B).

One of ordinary skill in the art at the time of the invention would recognize that since the rate of innovation is defined by the total degrees of freedom of the wanted signal it would be obvious that Unser discloses sampling a signal at the rate of innovation for reconstructing in the digital domain. Furthermore, one of ordinary skill in the art at the time of the invention would clearly recognize the benefits of optimizing the sampling frequency, where sampling at a lower rate has the advantages of decreasing

processing speed and power dissipation of the processing elements, while sampling at a higher rate decreases distortion (due to aliasing) in the sampled signal.

Therefore it would be obvious to one of ordinary skill in the art at the time of the invention to modify (lower) the sampling rate (frequency) of Affes with the teachings Unser in order to sample the received signal at a frequency lower than the chip rate of said received signal, but greater than the rate of innovation of said received signal, since such a modification has the advantages of minimizing the receiver complexity (i.e. processing speed and power dissipation), and minimizing the distortion (due to aliasing) introduced into the wanted signal due to sampling below the Nyquist frequency (rate).

Limitation 2)

Affes in view of Unser teaches all of the subject matter as described above except for the method written by a software program loadable into the internal memory of the digital processing system, said program embodied in a computer-readable medium.

Langberg et al. teaches that the method and apparatus for a transceiver warm start activation procedure with pre-coding can be implemented in software stored in a computer-readable medium. The computer-readable medium is an electronic, magnetic, optical, or other physical device or means that can contain or store a computer program for use by or in connection with a computer-related system or method (col. 3, lines 51-65). One skilled in the art would have clearly recognized that the method of Affes in view of Unser would have been implemented in software. The implemented software would perform the same function of the hardware for less

expense, and have increased adaptability, and flexibility. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the software as taught by Langberg et al. in the method of Affes in view of Unser in order to reduce cost and improve the adaptability and flexibility of the communication system.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

10. Pedersen et al. (US 2004/0057593) discloses under-sampling (below the Nyquist frequency) at least one received signal to yield the benefits of reducing the computational loading of a digital signal processor (DSP), even though under-sampling introduces distortion (due to aliasing) into the sampling signal (paragraph 81). Furthermore, an under-sampling factor is selected (having a value between 2 and 8) to optimize the sampling frequency (rate) (paragraph 81).

Haga et al. (USPN 6,507,603) discloses a CDMA communication system wherein the sampling rate is adapted (optimized) with reference to the channel condition (col. 4, lines 23-39 and col. 11, line 61 through col. 12, line 6). Specifically when the reception state (channel quality) is good the sampling rate is decreased in order to reduce the operation speed of the processing elements thus reducing power consumption; and when reception state is poor the sampling rate is enlarged to improve precision (col. 4, lines 23-39 and col. 11, line 61 through col. 12, line 6). Wherein sampling at the chip

frequency of a spread spectrum signal is discloses as being known in the art (col. 3, lines 7-13).

Pawelski (USPN 4,716,453) discloses that the sampling rate (bits per sample) is directly related to the quality of the received signal, efforts to balance (optimize) signal quality vs. cost (of the communication system) have led receivers to sample at sub-Nyquist sampling rates even though sampling at sub-Nyquist rates introduces distortion (such as aliasing) in the wanted signal (col. 1, lines 40-53 and col. 1, line 67 through col. 2, line 9).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAMES M. PEREZ whose telephone number is (571)270-3231. The examiner can normally be reached on Monday through Friday: 9am to 5pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shuwang Liu can be reached on 571-272-3036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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